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10 CFR 50.73

June 19, 2019

Serial: RA-19-0263

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Brunswick Steam Electric Plant, Unit No. 1
Renewed Facility Operating License No. DPR-71
Docket No. 50-325
Licensee Event Report 1-2019-003

In accordance with the Code of Federal Regulations, Title 10, Part 50.73, Duke Energy Progress, LLC, submits the enclosed Licensee Event Report (LER). This report fulfills the requirement for a written report within sixty (60) days of a reportable occurrence.

This document contains no regulatory commitments.

Please refer any questions regarding this submittal to Mr. Jerry Pierce, Manager – Nuclear Support Services, at (910) 832-7931.

Sincerely,

A handwritten signature in black ink, appearing to read 'W. Gideon', written over a horizontal line.

William R. Gideon

SBY/sby

Enclosure: Licensee Event Report

cc (with enclosure):

U. S. Nuclear Regulatory Commission, Region II
ATTN: Ms. Catherine Haney, Regional Administrator
245 Peachtree Center Ave, NE, Suite 1200
Atlanta, GA 30303-1257

U. S. Nuclear Regulatory Commission
ATTN: Mr. Gale Smith, NRC Senior Resident Inspector
8470 River Road
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4325 Mail Service Center
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**LICENSEE EVENT REPORT (LER)**

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. Facility Name

Brunswick Steam Electric Plant (BSEP), Unit 1

2. Docket Number

05000325

3. Page

1 OF 3

4. Title

False High Reactor Water Level Results in Automatic Specified System Actuations

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Rev No.	Month	Day	Year	Facility Name	Docket Number
04	21	2019	2019	- 003	- 00	06	19	2019	Facility Name	Docket Number
9. Operating Mode										
11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply)										
1			<input type="checkbox"/> 20.2201(b)		<input type="checkbox"/> 20.2203(a)(3)(i)		<input type="checkbox"/> 50.73(a)(2)(ii)(A)		<input type="checkbox"/> 50.73(a)(2)(viii)(A)	
			<input type="checkbox"/> 20.2201(d)		<input type="checkbox"/> 20.2203(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(ii)(B)		<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
			<input type="checkbox"/> 20.2203(a)(1)		<input type="checkbox"/> 20.2203(a)(4)		<input type="checkbox"/> 50.73(a)(2)(iii)		<input type="checkbox"/> 50.73(a)(2)(ix)(A)	
			<input type="checkbox"/> 20.2203(a)(2)(i)		<input type="checkbox"/> 50.36(c)(1)(i)(A)		<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)		<input type="checkbox"/> 50.73(a)(2)(x)	
10. Power Level			<input type="checkbox"/> 20.2203(a)(2)(ii)		<input type="checkbox"/> 50.36(c)(1)(ii)(A)		<input type="checkbox"/> 50.73(a)(2)(v)(A)		<input type="checkbox"/> 73.71(a)(4)	
100			<input type="checkbox"/> 20.2203(a)(2)(iii)		<input type="checkbox"/> 50.36(c)(2)		<input type="checkbox"/> 50.73(a)(2)(v)(B)		<input type="checkbox"/> 73.71(a)(5)	
			<input type="checkbox"/> 20.2203(a)(2)(iv)		<input type="checkbox"/> 50.46(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(v)(C)		<input type="checkbox"/> 73.77(a)(1)	
			<input type="checkbox"/> 20.2203(a)(2)(v)		<input type="checkbox"/> 50.73(a)(2)(i)(A)		<input type="checkbox"/> 50.73(a)(2)(v)(D)		<input type="checkbox"/> 73.77(a)(2)(i)	
			<input type="checkbox"/> 20.2203(a)(2)(vi)		<input type="checkbox"/> 50.73(a)(2)(i)(B)		<input type="checkbox"/> 50.73(a)(2)(vii)		<input type="checkbox"/> 73.77(a)(2)(ii)	
					<input type="checkbox"/> 50.73(a)(2)(i)(C)		<input type="checkbox"/> Other (Specify in Abstract below or in NRC Form 366A)			

12. Licensee Contact for this LER**Licensee Contact**

Jerry Pierce, Manager – Nuclear Support Services

Telephone Number (Include Area Code)

(910) 832-7931

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to ICES	Cause	System	Component	Manufacturer	Reportable to ICES
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14. Supplemental Report Expected☐ Yes (If yes, complete 15. Expected Submission Date) ☒ No**15. Expected Submission Date**

Month Day Year

Abstract (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

At 23:07 Eastern Daylight Time on April 21, 2019, with Unit 1 in Mode 1 at approximately 100 percent power, the Main Turbine and both Reactor Feed Pumps (RFPs) tripped resulting in a reactor scram and reactor water level dropping below Low Level (LL) 1 and 2. The LL1 resulted in Group 2 (i.e., floor and equipment drain isolation valves), Group 6 (i.e., monitoring and sampling isolation valves), and Group 8 (i.e., shutdown cooling isolation valves) isolations. The LL2 resulted in Group 3 (i.e., Reactor Water Cleanup) isolation, a secondary containment isolation signal, and High Pressure Coolant Injection and Reactor Core Isolation Cooling (RCIC) automatically starting and injecting into the vessel. All control rods inserted as expected during the scram and all systems responded as designed.

The Main Turbine and both RFPs tripped due to two out of three level instruments sensing a false high reactor water level. The false signal was a result of hydrogen deflagration in the reactor level condensing chamber due to a flaw in the original design.

There was no impact on the health and safety of the public or plant personnel. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) due to actuations of the Reactor Protection System, Primary Containment Isolation System, Emergency Core Cooling System, and RCIC.

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

(See NUREG-1022, R.3 for instruction and guidance for completing this form
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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Brunswick Steam Electric Plant (BSEP), Unit 1	05000325	2019	- 003	- 00

NARRATIVE

Energy Industry Identification System (EIIIS) codes are identified in the text as [XX].

Background*Initial Conditions*

At the time of the event, Unit 1 was in Mode 1 (i.e., Power Operation), at approximately 100 percent rated thermal power.

Reportability Criteria

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) because it involved actuation of systems listed in 10 CFR 50.73(a)(2)(iv)(B). Specifically, the Reactor Protection System [JC], Primary Containment Isolation System [JM], Emergency Core Cooling System [BJ], and Reactor Core Isolation Cooling [BN] actuated during this event.

The NRC was notified of this event per 10 CFR 50.72(b)(2)(iv)(A), 10 CFR 50.72(b)(2)(iv)(B), and 10 CFR 50.72(b)(3)(iv)(A) via Event Notification 54016 at 01:51 Eastern Daylight Time (EDT) on April 22, 2019.

Event Description

At 23:07 EDT on April 21, 2019, in Mode 1 at approximately 100 percent reactor power, Unit 1 automatically tripped due to a Main Turbine trip. The Main Turbine trip was a result of two out of three reactor level instruments sensing a false high reactor water level. All control rods inserted as expected during the scram. Safety Relief Valves G and K lifted per design. The same level instruments that failed also tripped both Reactor Feed Pumps. As a result, reactor water level dropped below the Low Level (LL) 1 and 2 actuation setpoints. Per design, the LL1 signal resulted in Group 2 (i.e., floor and equipment drain isolation valves), Group 6 (i.e., monitoring and sampling isolation valves) and Group 8 (i.e., shutdown cooling isolation valves) isolations. The LL2 signals resulted in Group 3 (i.e., Reactor Water Cleanup) isolation, a secondary containment isolation signal, and an automatic start of Standby Gas Treatment and Control Room Emergency Ventilation. Also, the LL2 resulted in High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) System automatically starting and injecting into the Reactor Pressure Vessel (RPV).

Event Cause

The direct cause of the false high reactor water level signal on two out of three level instruments was hydrogen deflagration in the associated condensing chambers. The root cause of this event was a flaw in the original design of the reactor level instrument condensing chambers that made them susceptible to accumulation of a flammable mixture of hydrogen and oxygen under certain conditions. A contributing cause to this event was that the Brunswick evaluation of General Electric (GE) Service Information Letter (SIL) 643, "Potential for radiolytic gas detonation," did not fully address the vulnerability to hydrogen accumulation in the reactor level instrument condensing chambers.

The two level instruments that sensed the false high reactor water level both have reference legs connected to the N12A RPV nozzle. These reactor level instruments indicated high level for a few seconds, then returned to normal. There was no actual high reactor level condition as verified by other indications.

At the time of the event, Unit 1 had been on-line for approximately 10 days. The previous outage (i.e., approximately 10 days before the event) was the result of the failure of a cryogenic fitting on the steam line to the reactor level instrument condensing chambers on the N12B nozzle. During the outage, cryogenic fittings on the steam lines from the N12A and N12B nozzles were replaced.

When the cryogenic couplings were replaced with welded fittings, the RPV level was reduced to below the N12A and N12B nozzles and air was introduced into the steam lines and condensing chambers for the level instruments. Air is rarely introduced into the condensing chambers; before this event the last maintenance that resulted in air introduction occurred in 1989. For deflagration to occur in the condensing chambers, hydrogen and oxygen must be present. The oxygen generated during normal operation does not support deflagration. During normal operation and refueling outages, there is effectively no opportunity for air to be introduced into the RPV level instrument reference leg condensing chambers. No air is present in the RPV during operation, and reactor water level

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Brunswick Steam Electric Plant (BSEP), Unit 1	05000325	2019	- 003	- 00

NARRATIVE

is maintained above the instrument nozzles when the reactor is shutdown except for a brief period during reactor startup when the vessel level is lowered with the head vents open. There is no flow path through the condensing chamber during this period, so the amount of exchange within the chamber is minimal.

When the replacement work was complete, the reference leg was refilled using demineralized water via the Control Rod Drive System reference leg backfill system. The RPV level instruments were calibrated and verified to be working properly. Unit 1 was started up, synchronized to the grid on April 11, and operated at full power prior to this event.

The condensing chambers are a local high point for the level instrument piping. Therefore, hydrogen will accumulate in the condensing chamber and steam piping as steam is condensed. Because of the introduction of air during the coupling replacement work, over time the hydrogen mixed with the trapped air, creating a more unstable mixture than the typical steam/hydrogen mixture. At 23:06 on April 21, the hydrogen-air mixture ignited releasing energy and resulting in a pressure spike followed by a collapse of the gas volume which created a vacuum in the condensing chambers and resulted in the indicated reactor level to register an increase on the affected instruments connected to the N12A nozzle.

Safety Assessment

There was no adverse impact on the health and safety of the public. The safety significance of this event is minimal. The automatic reactor trip was not complicated and all safety related systems operated as designed.

Corrective Actions

Prior to restart from this event, the Unit 1 level instrument reference legs connected to the N12A and N12B RPV nozzles were flushed with high velocity demineralized water to remove trapped air. In addition, Unit 2 was verified to not be vulnerable to a similar event.

In addition to the aforementioned completed corrective actions, the following corrective actions are currently planned.

- Applicable procedures and drawings will be revised to include information that hydrogen may be present in the steam lines and condensing chambers connected to the N12A and N12B RPV nozzles and that purging these lines may be required if air is allowed to enter this area. These actions are scheduled to be completed by November 14, 2019.
- The original GE SIL 643 response will be reassessed using current Operating Experience and Vendor Technical Information Program guidance to ensure other vulnerabilities are adequately addressed and adequate technical rigor is applied. This action is scheduled to be completed by November 14, 2019.

Any changes to corrective actions or completion schedules will be made in accordance with the site's corrective action program.

Previous Similar Events

No events have occurred within the past three years in which a flaw in the original design resulted in a LER.

Commitments

No regulatory commitments are contained in this report.